

Self-Consistent Models for Geology and Mineralogy From Orbital and Opportunity Observations

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Overview

- Develop self-consistent models between orbital and Opportunity data, using ~22 km of traverses (“calibration alley”) and multiple orbital observations
- Validate processing and analysis of CRISM data
- Look ahead to Endeavour crater as “go to” site using new along-track oversampled CRISM observations

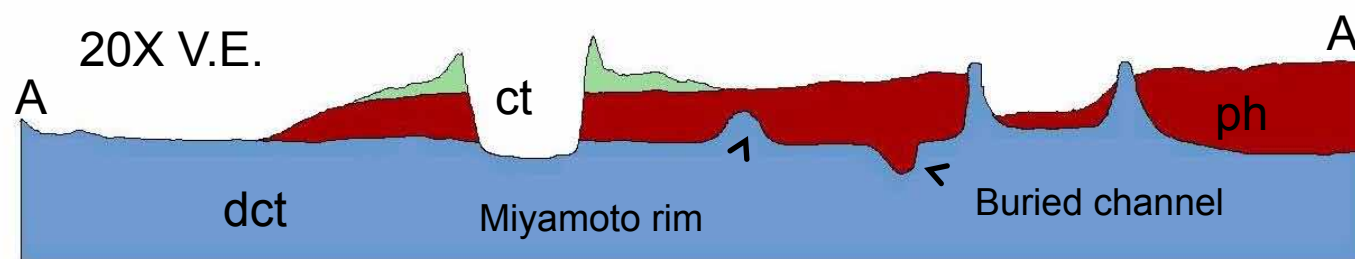
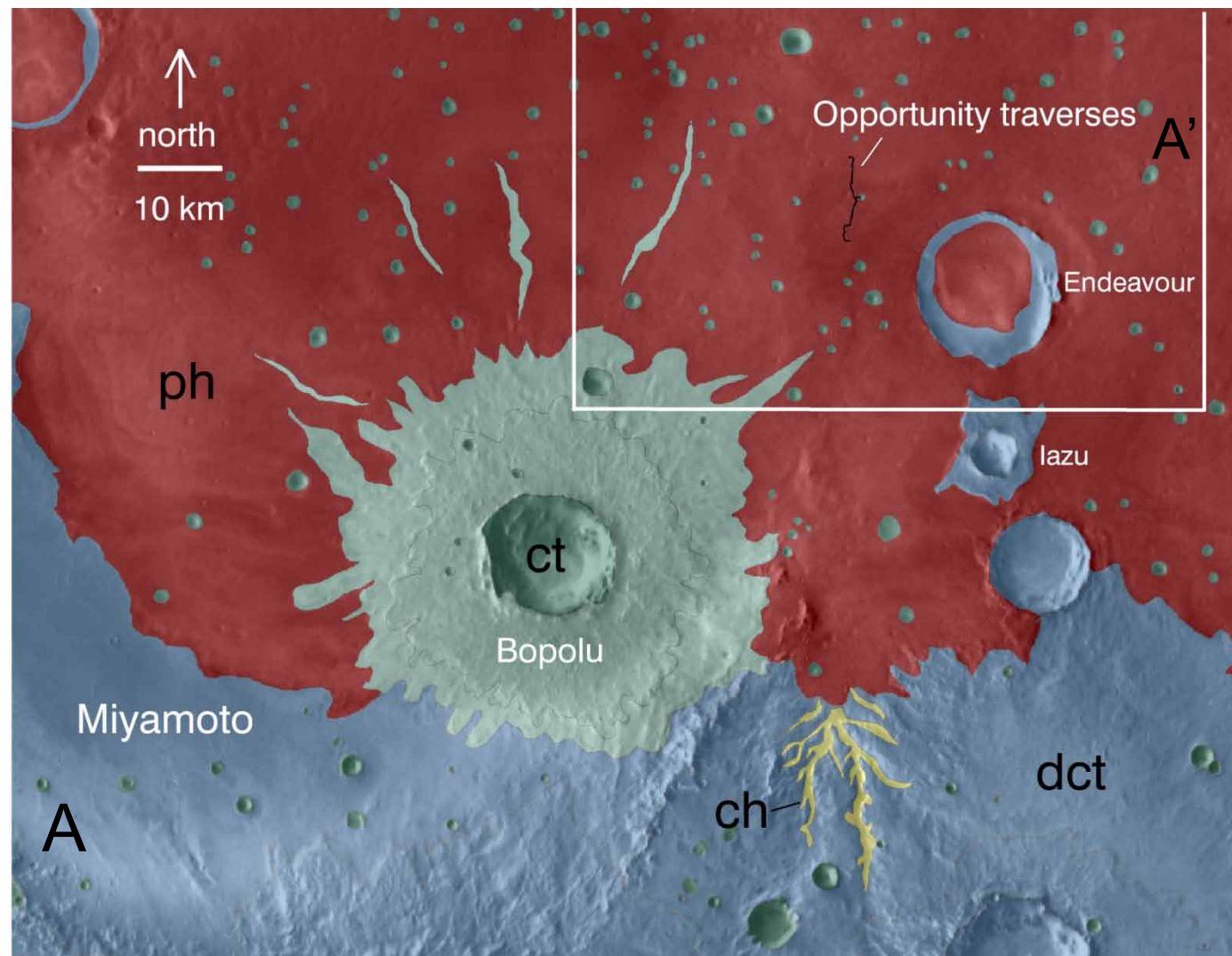
Meridiani Planum Geologic Setting

ct-post
Noachian
craters

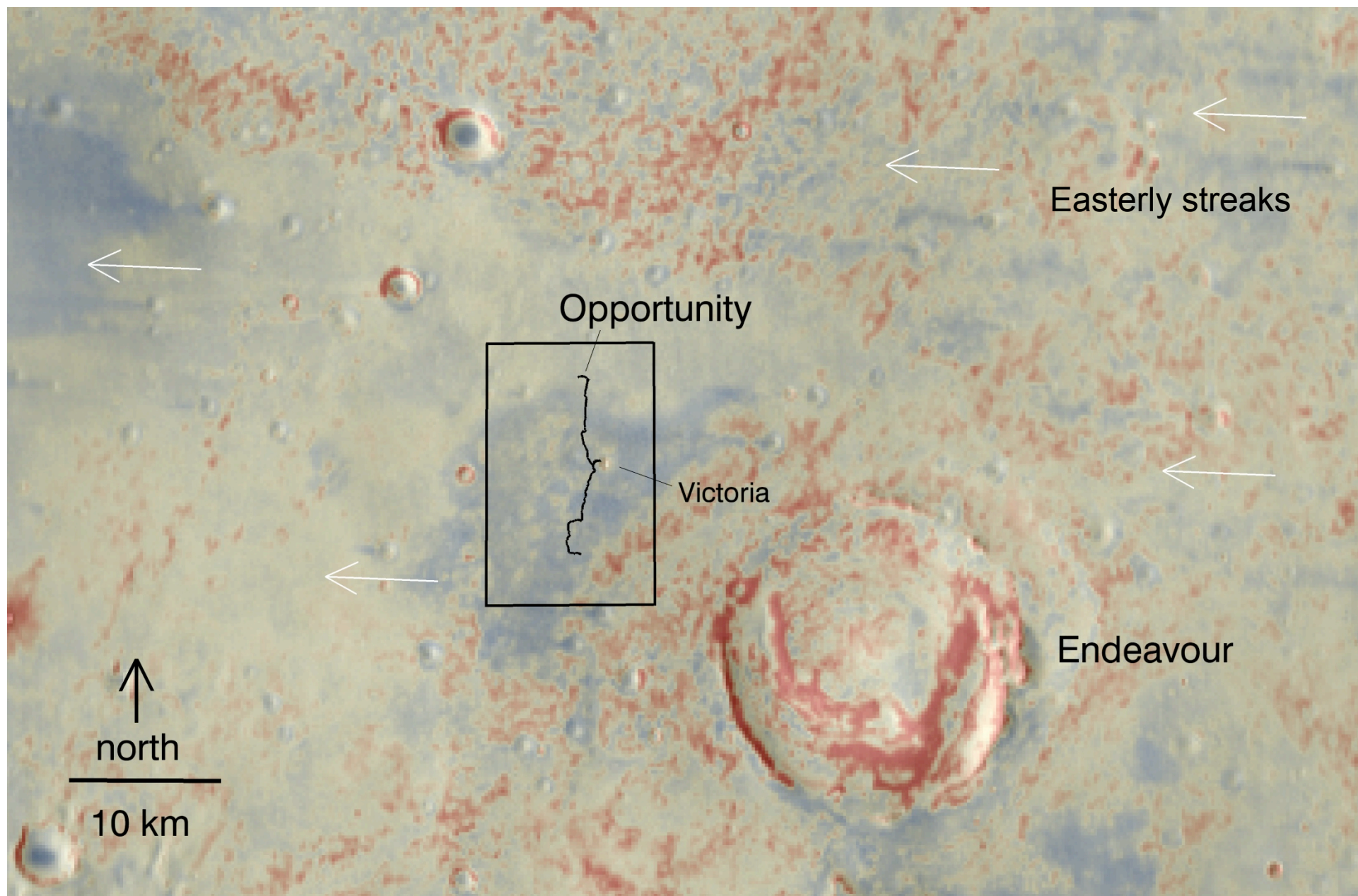
ph-hematite-
bearing plains

ch-channel

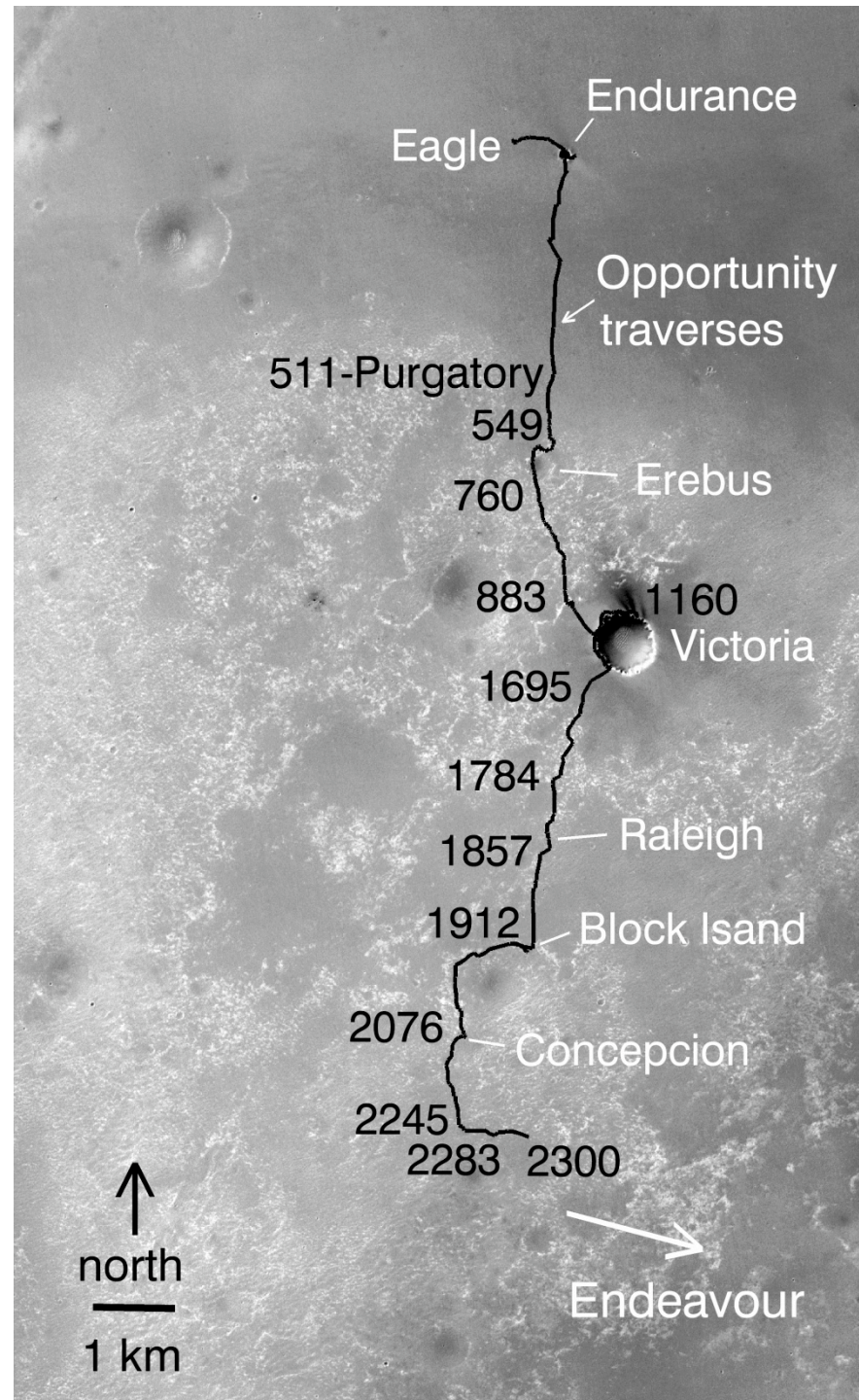
dct-Noachian
cratered
terrain



THEMIS-based predawn mosaic: blue=cold and red=warm

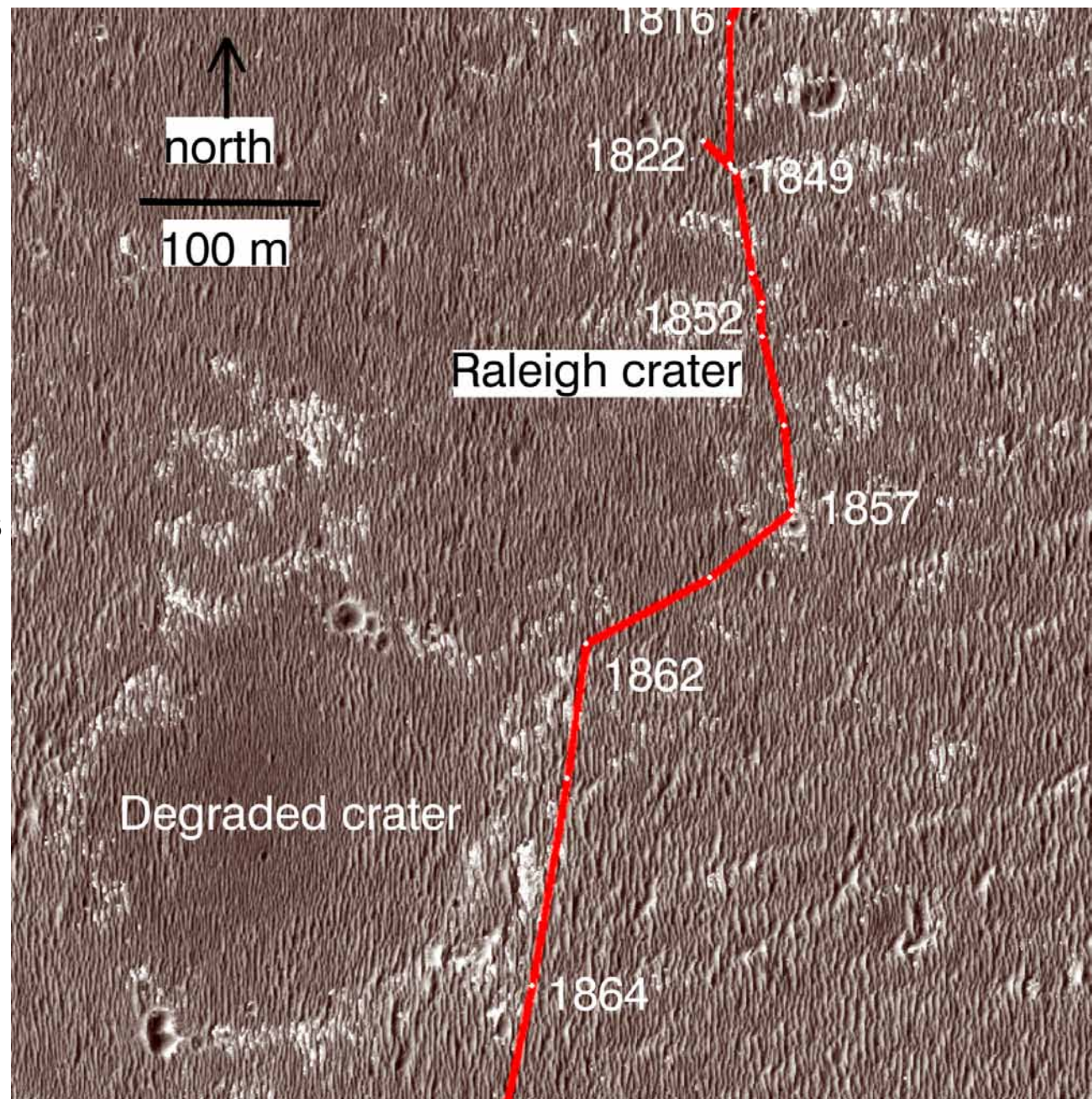


Portion of CTX
image with
Opportunity
traverses overlain

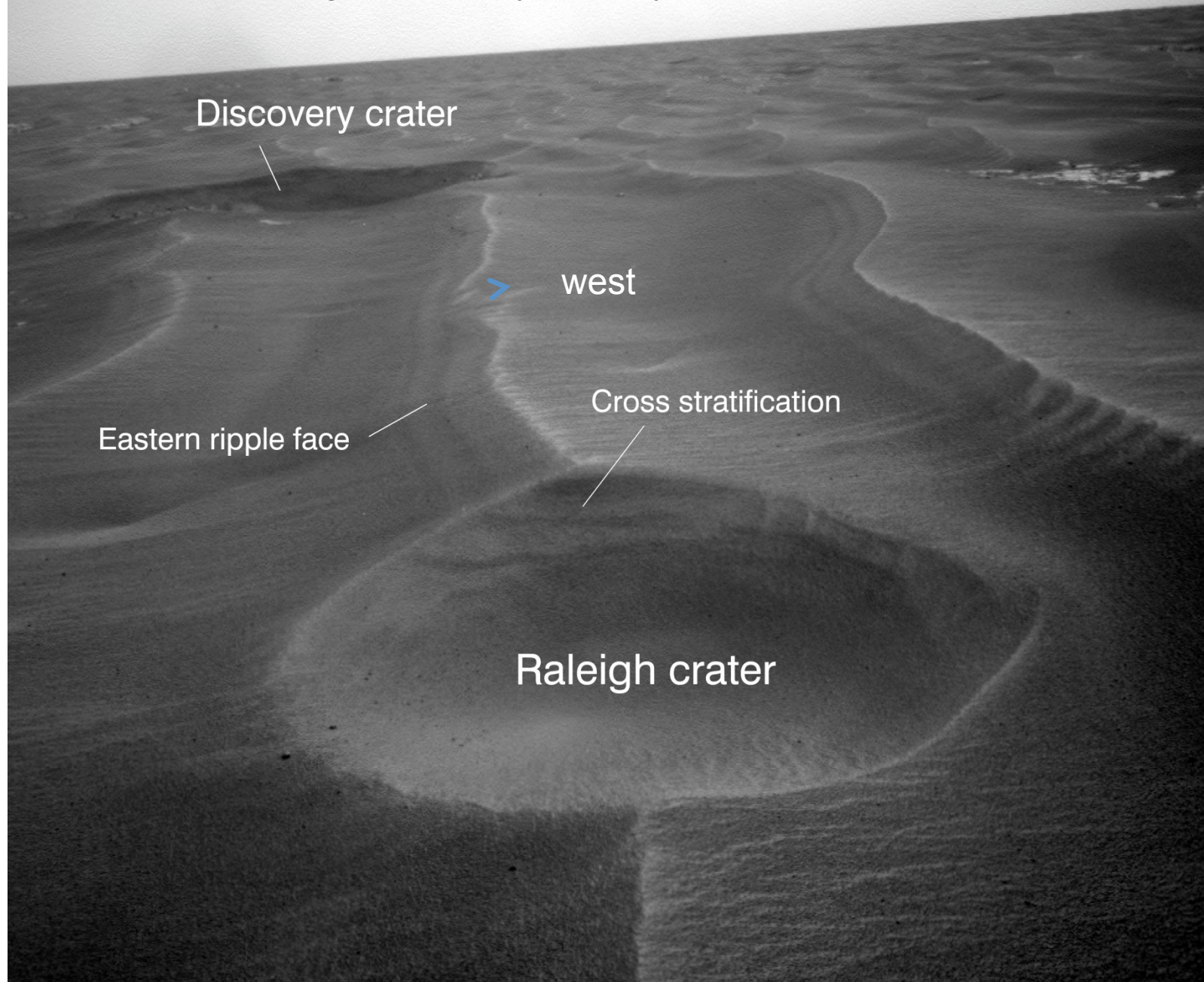


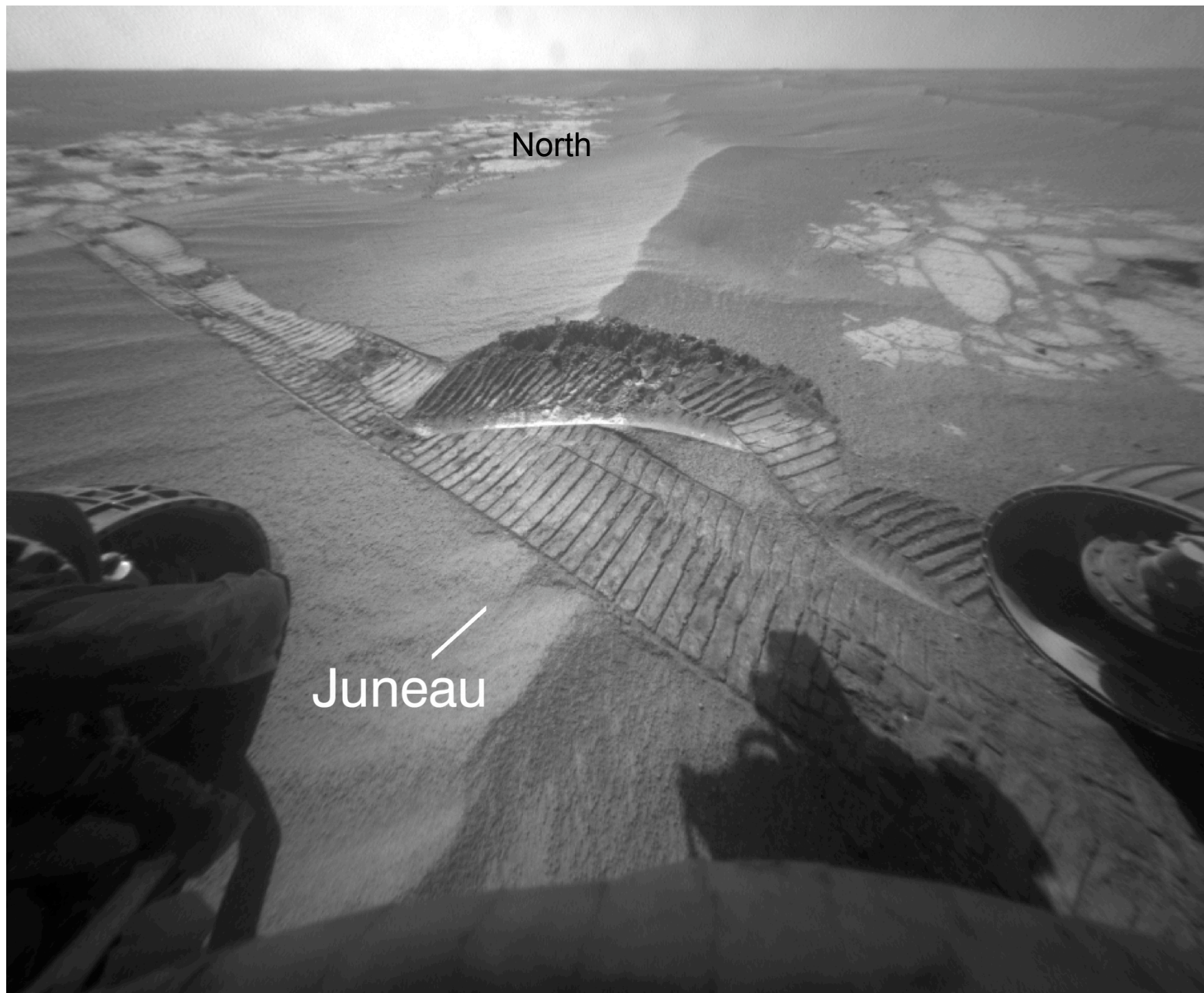
Portion of HiRISE
image south of
Victoria crater

Meridiani Planum
is dominated by
aeolian ripples and
sulfate-rich
sandstone outcrops



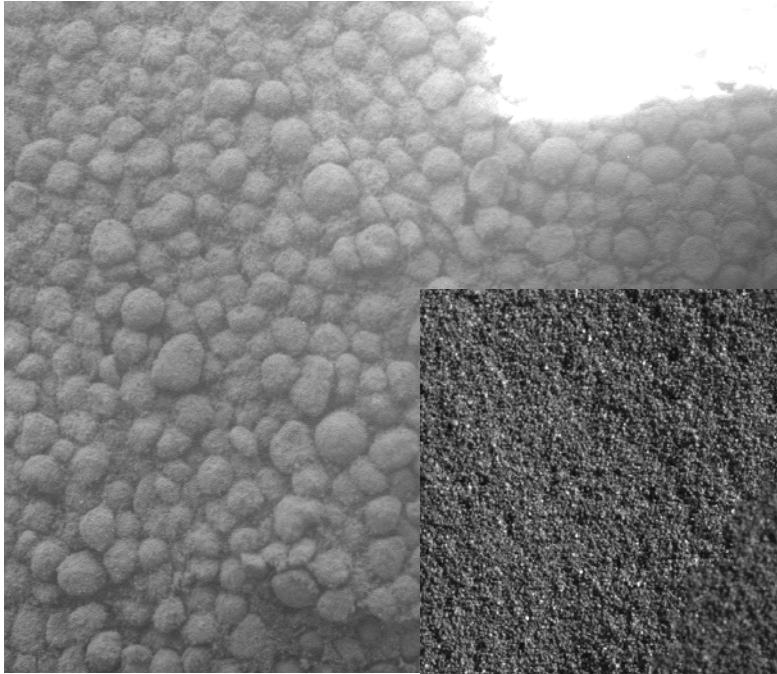
Granule ripples generated by easterly winds



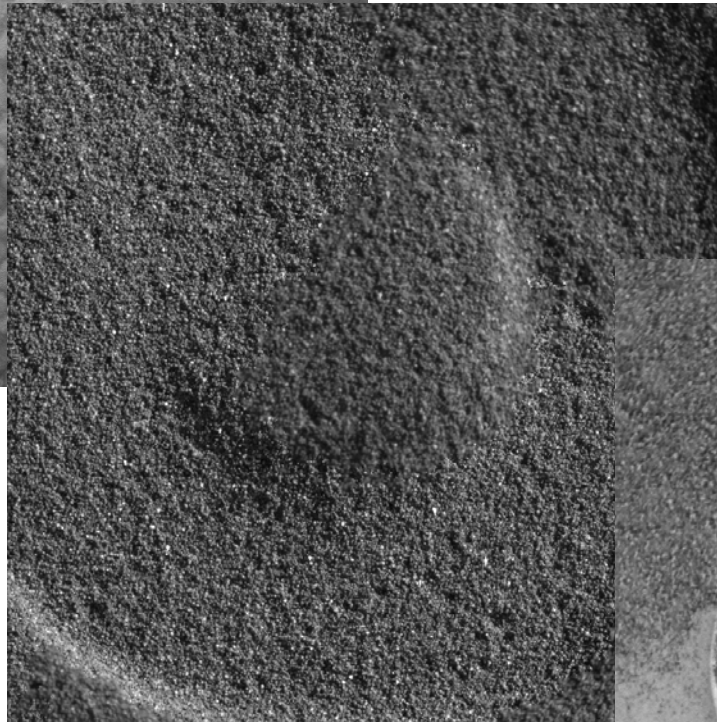


North

Juneau

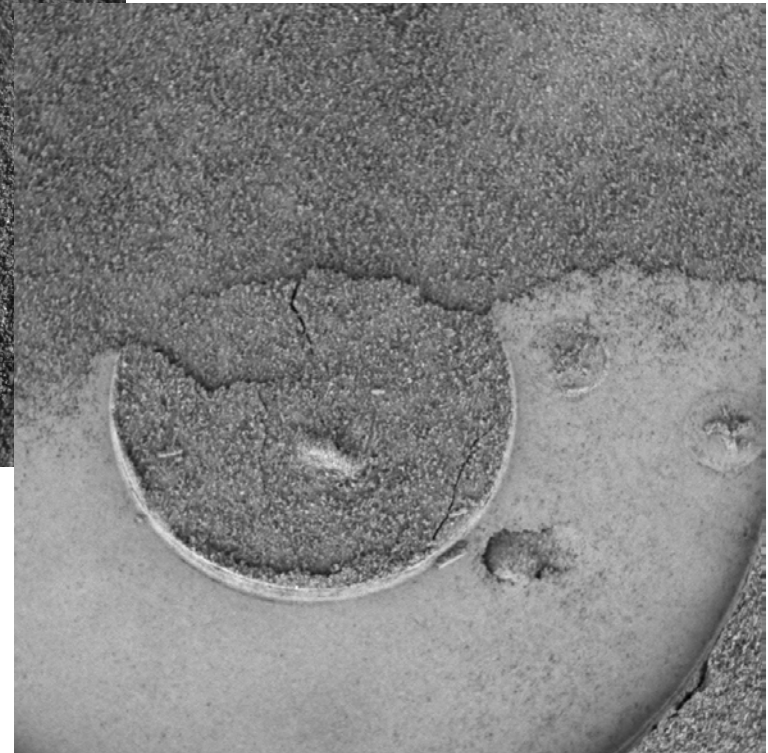


Aeolian cover = hematitic concretions,
basaltic sands, and dust



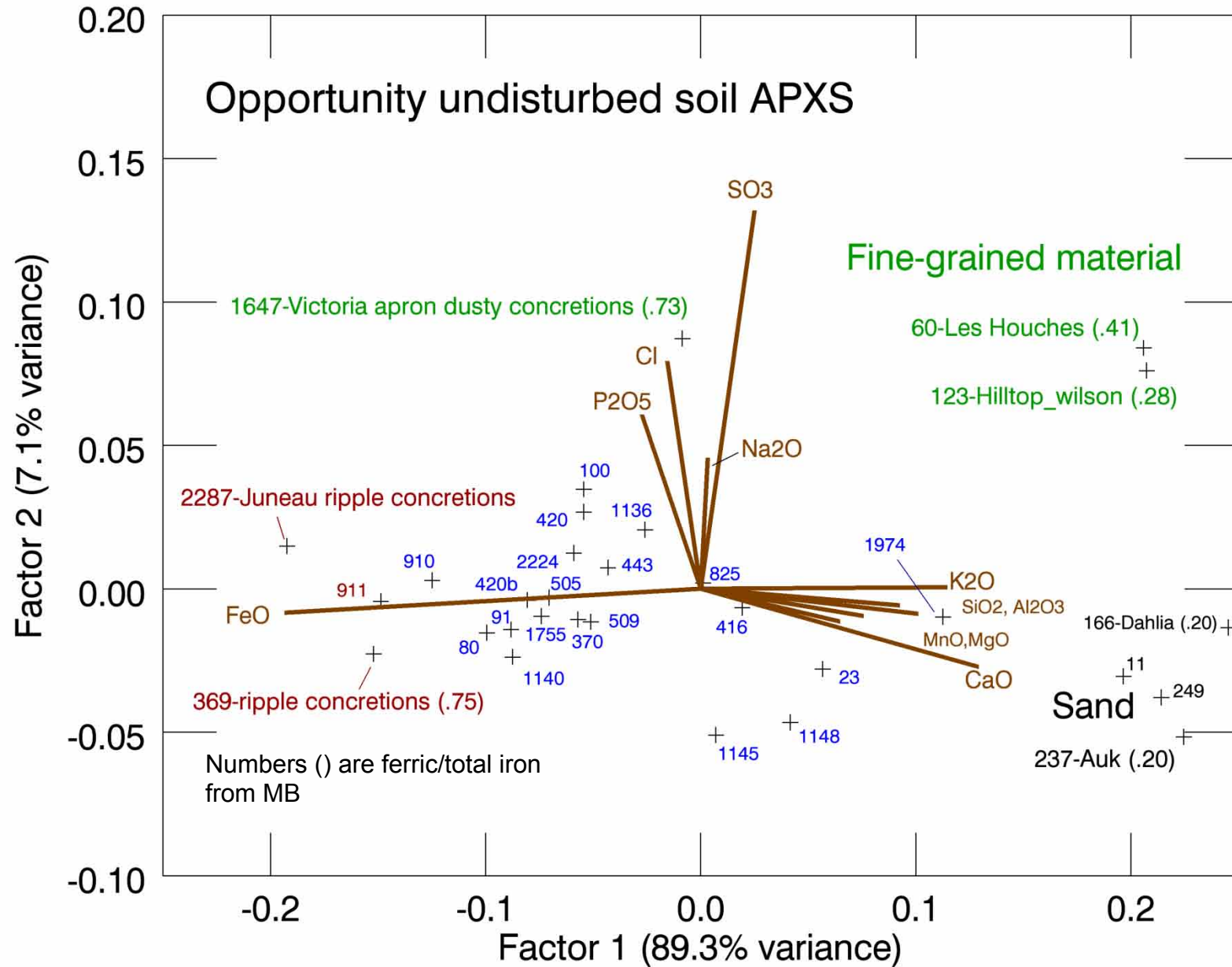
Sol 2297 Juneau
ripple

Sol 60 Les Houches fines



Sol 237 Auk sand

Hematitic concretions, basaltic sand, and dust

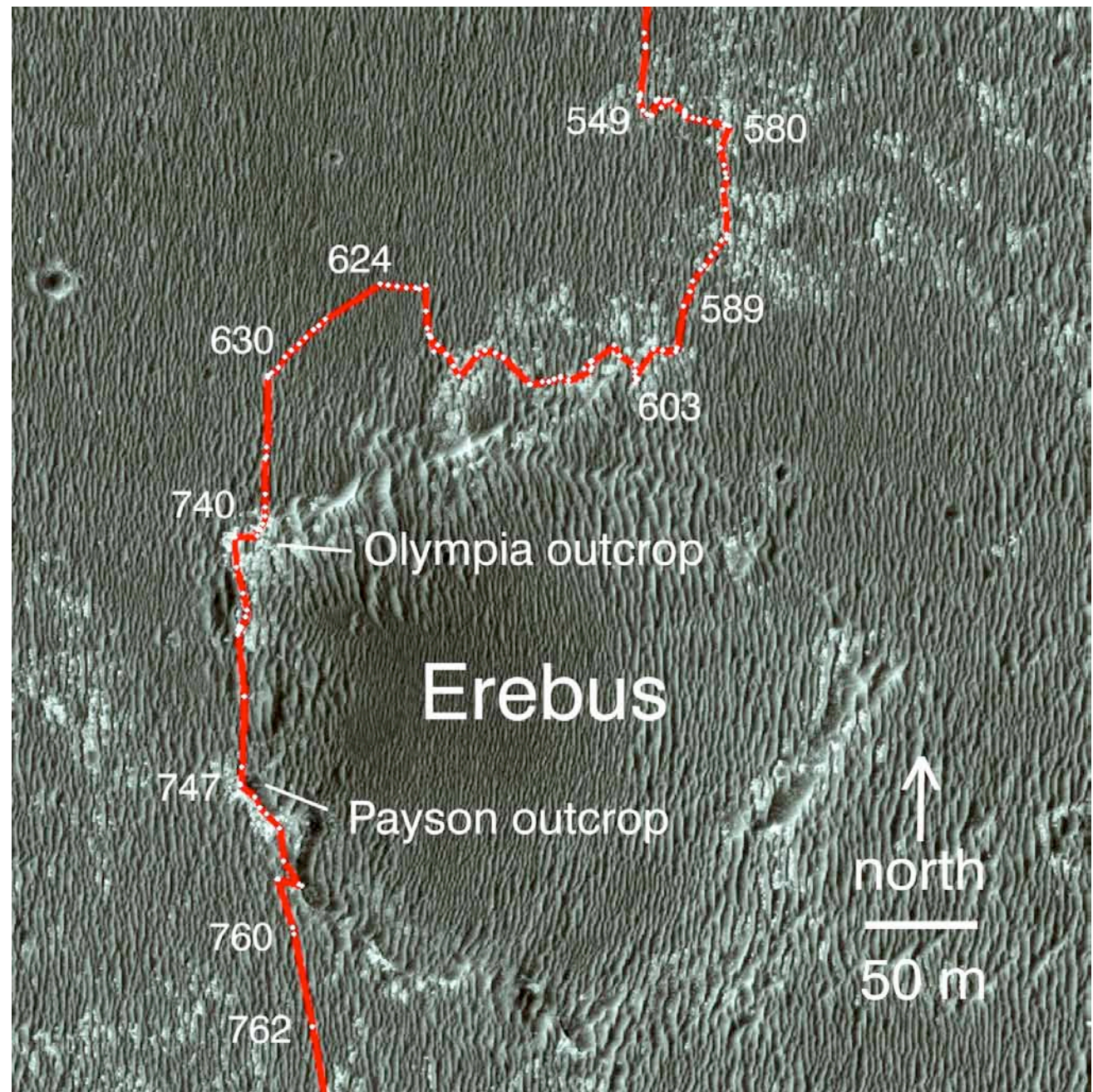


Portion of HiRISE
frame covering
Erebus crater
north of Victoria

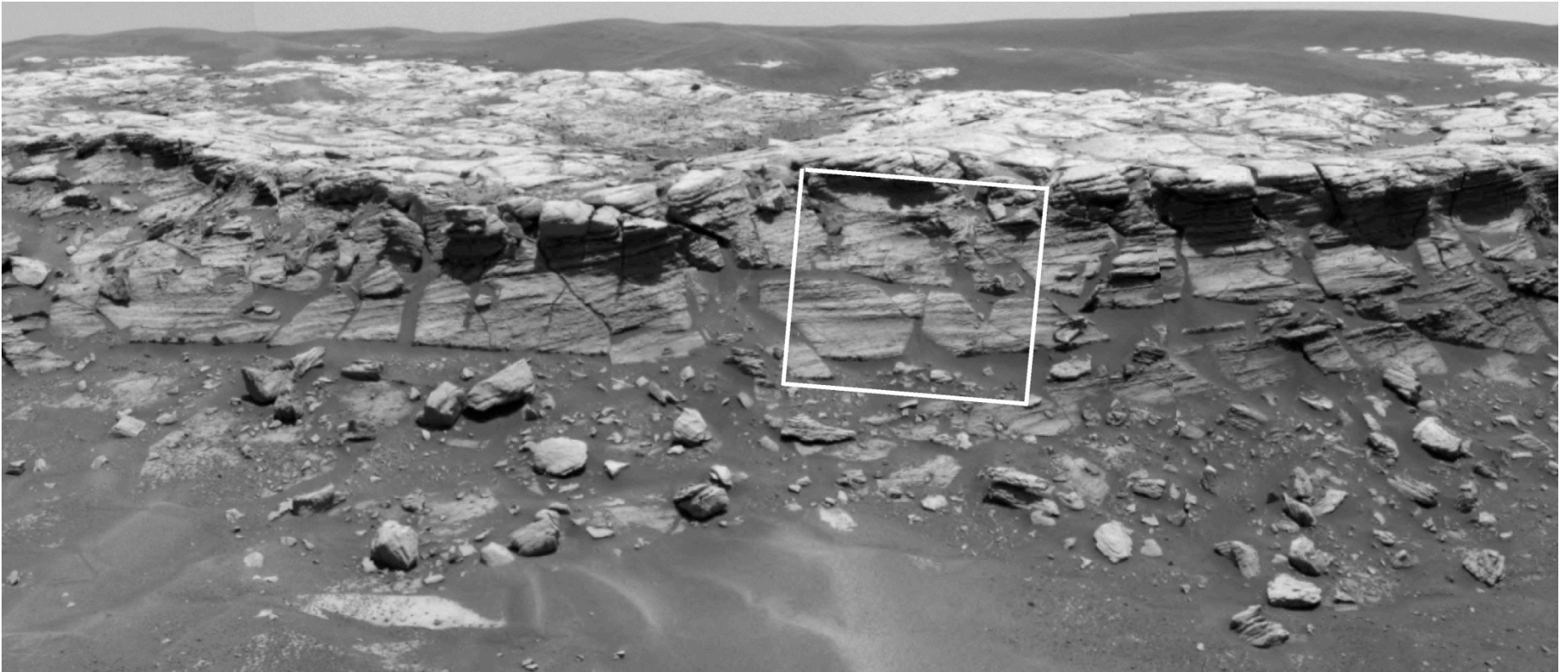
Examine sulfate-
rich sandstones

Aeolian sandstones
reworked in
ephemeral
playas

Sandstone source(s):
Mud facies?



Navcam view looking at Payson outcrop



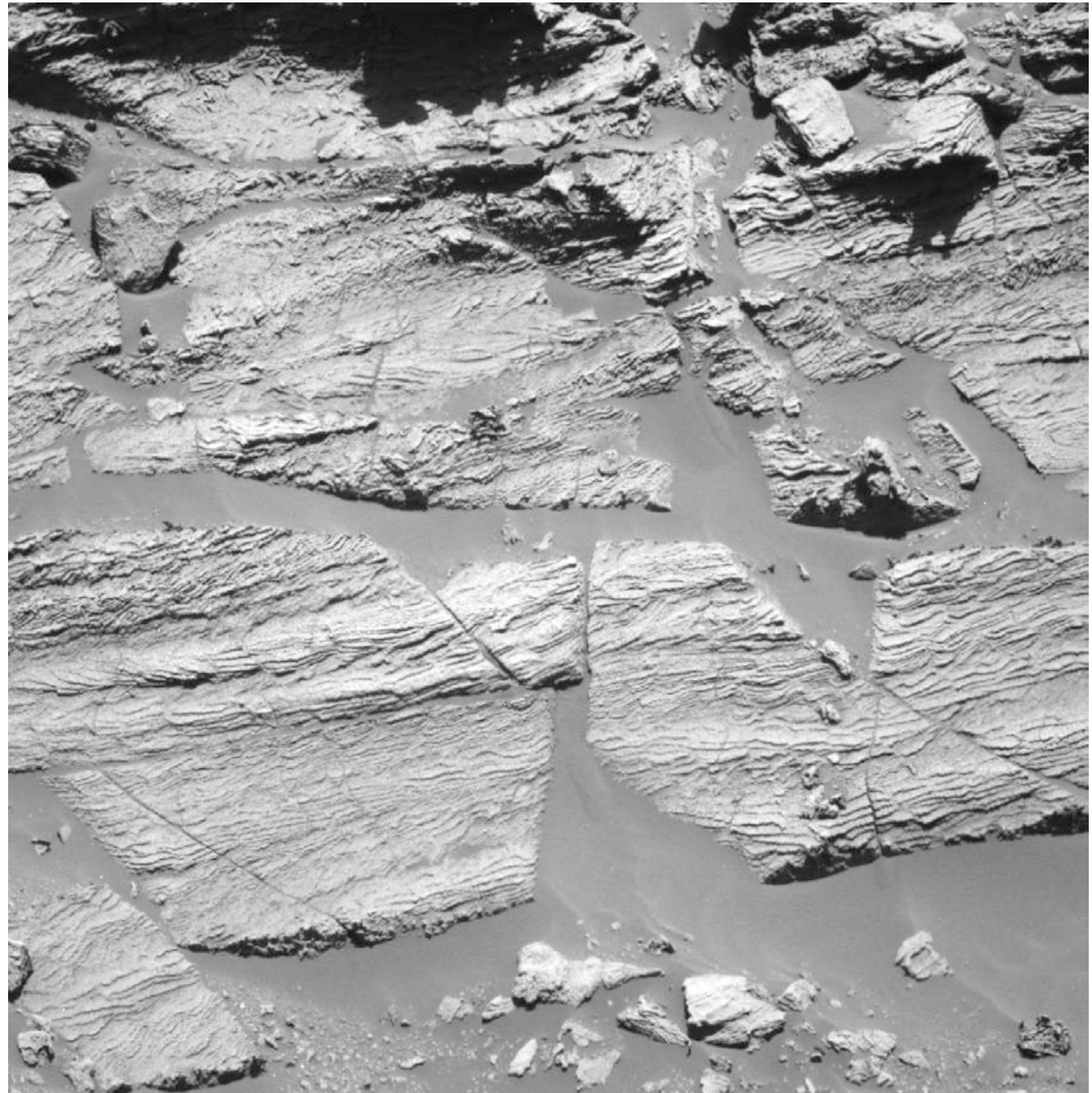
White box delineates Pancam view on next slide

Outcrop ~1.6 m high

Pancam view
showing shallow
water ripples

Mudcracks and
disrupted laminae
are also evident

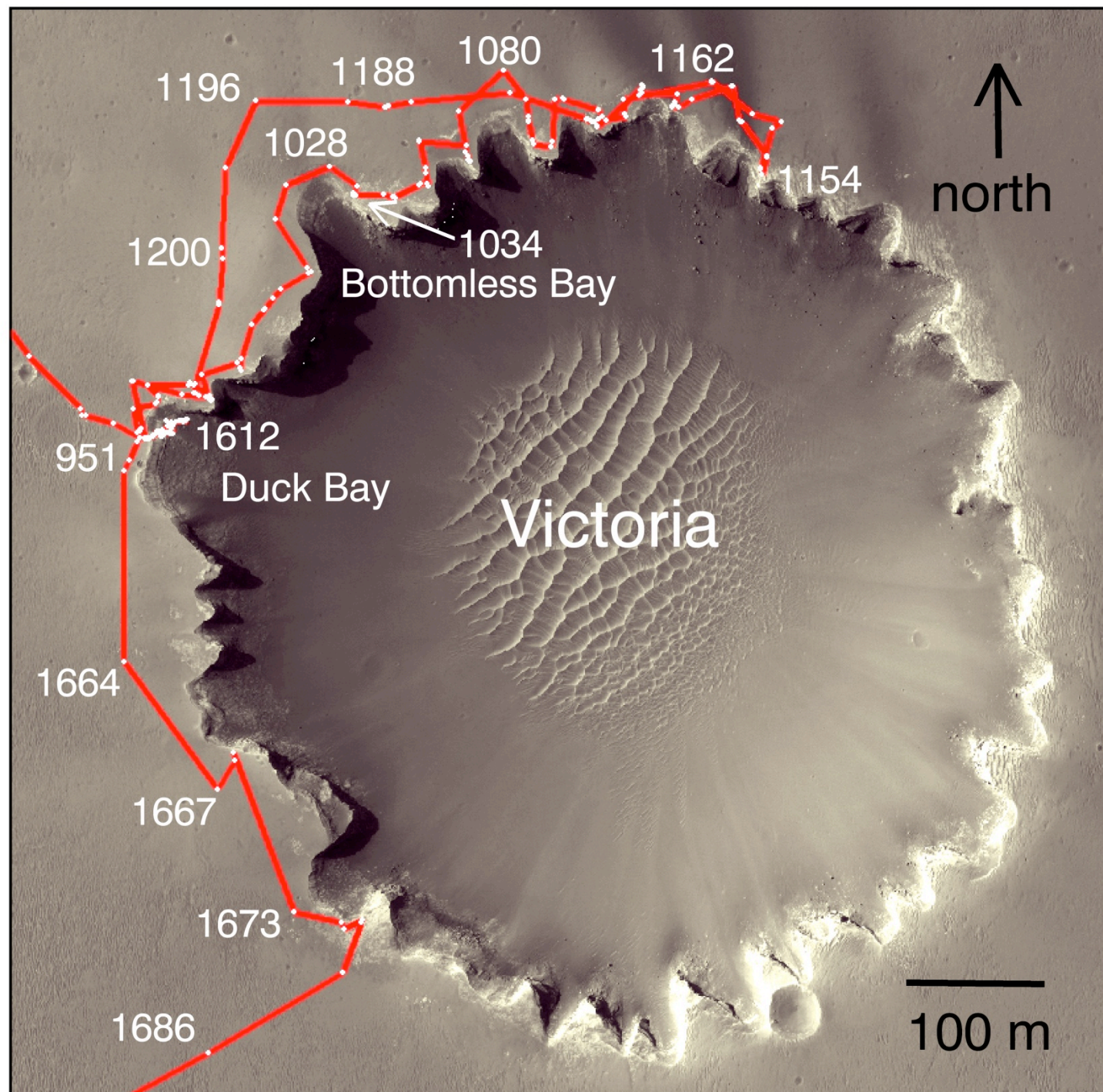
Good evidence for
shallow aqueous
transport of
sulfate-rich
sandstones



Portion of
HiRISE frame
covering
Opportunity
traverses around
and in Victoria

Duck Bay was
focus of in-situ
Campaign

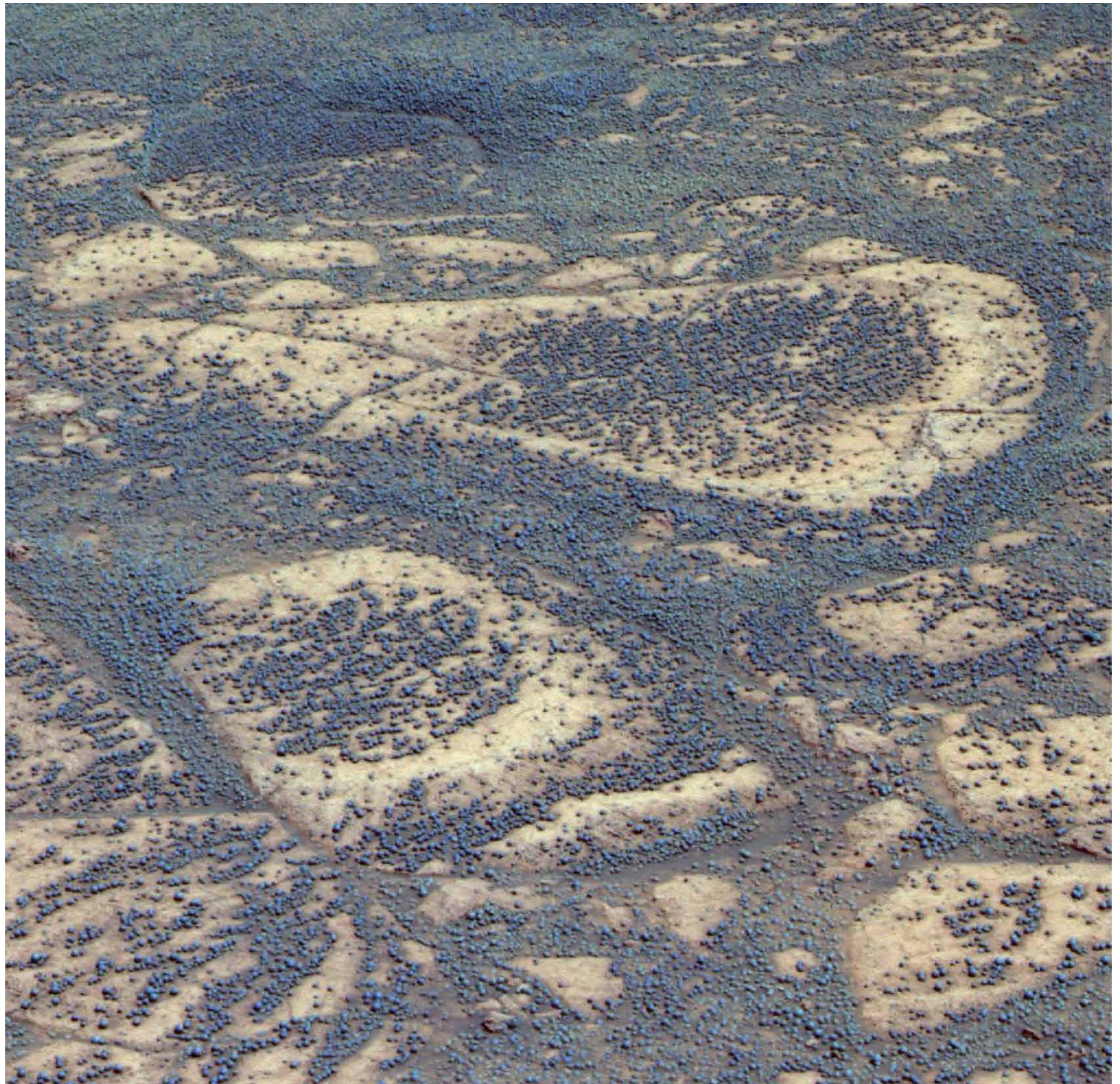
Sulfate-rich aeolian
sandstones altered
by groundwater



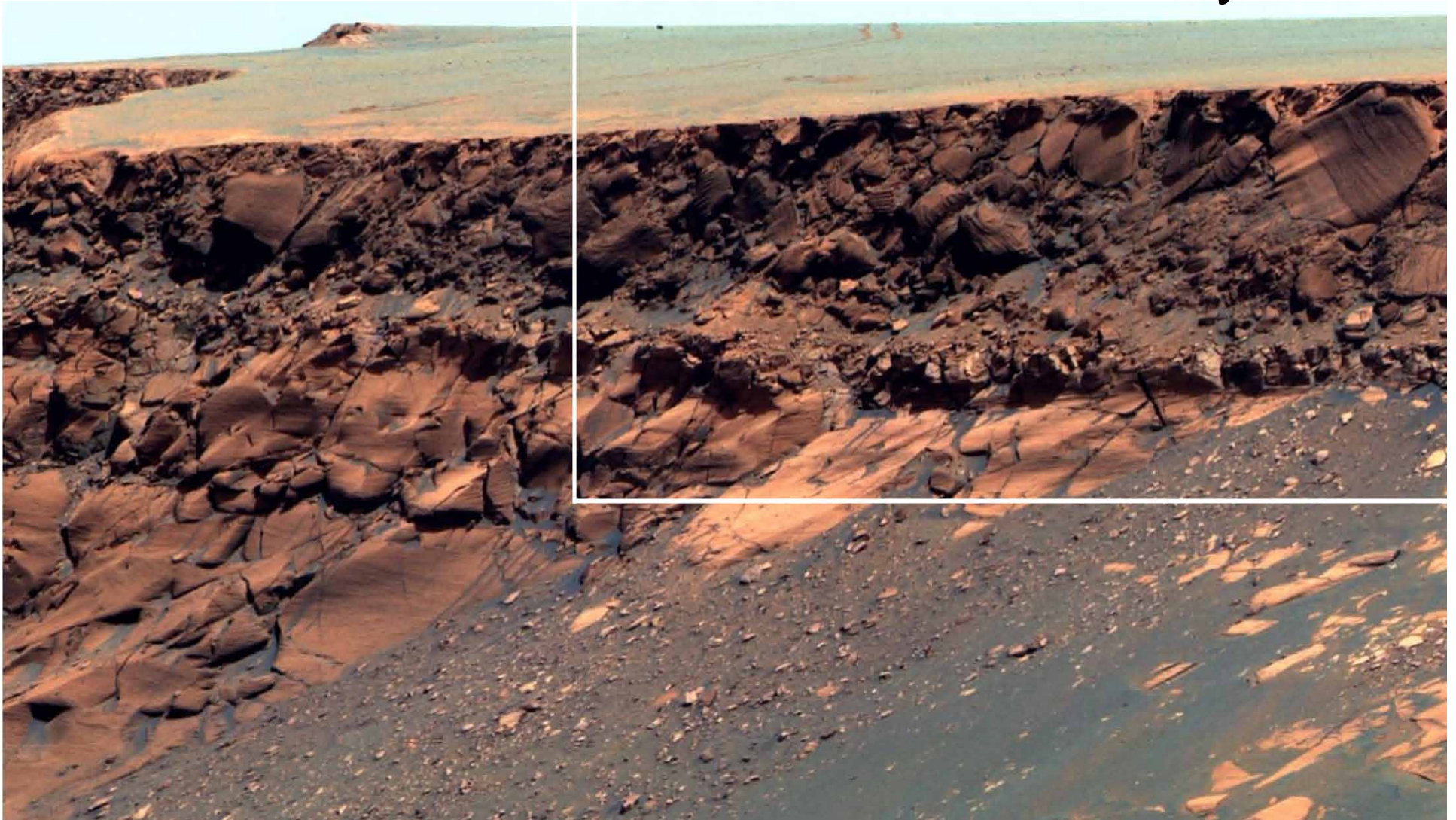
Pancam view
of portion of
ejecta annulus

Sandstones
beveled by wind
and covered by
basaltic sands
and hematitic
concretions

Tear-drop shaped
toulder top
~0.9 m long

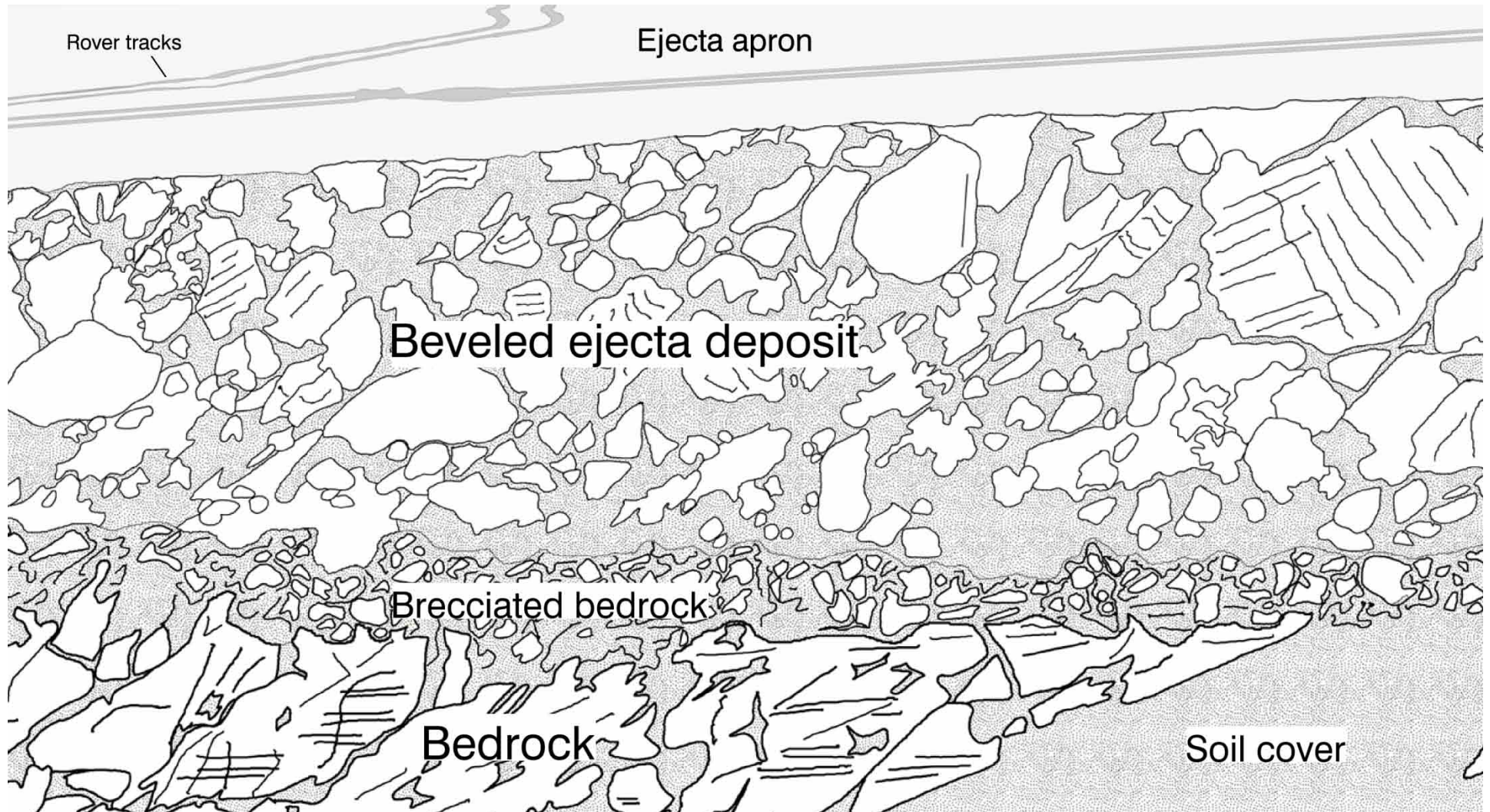


Portion of Pancam view of Bottomless Bay

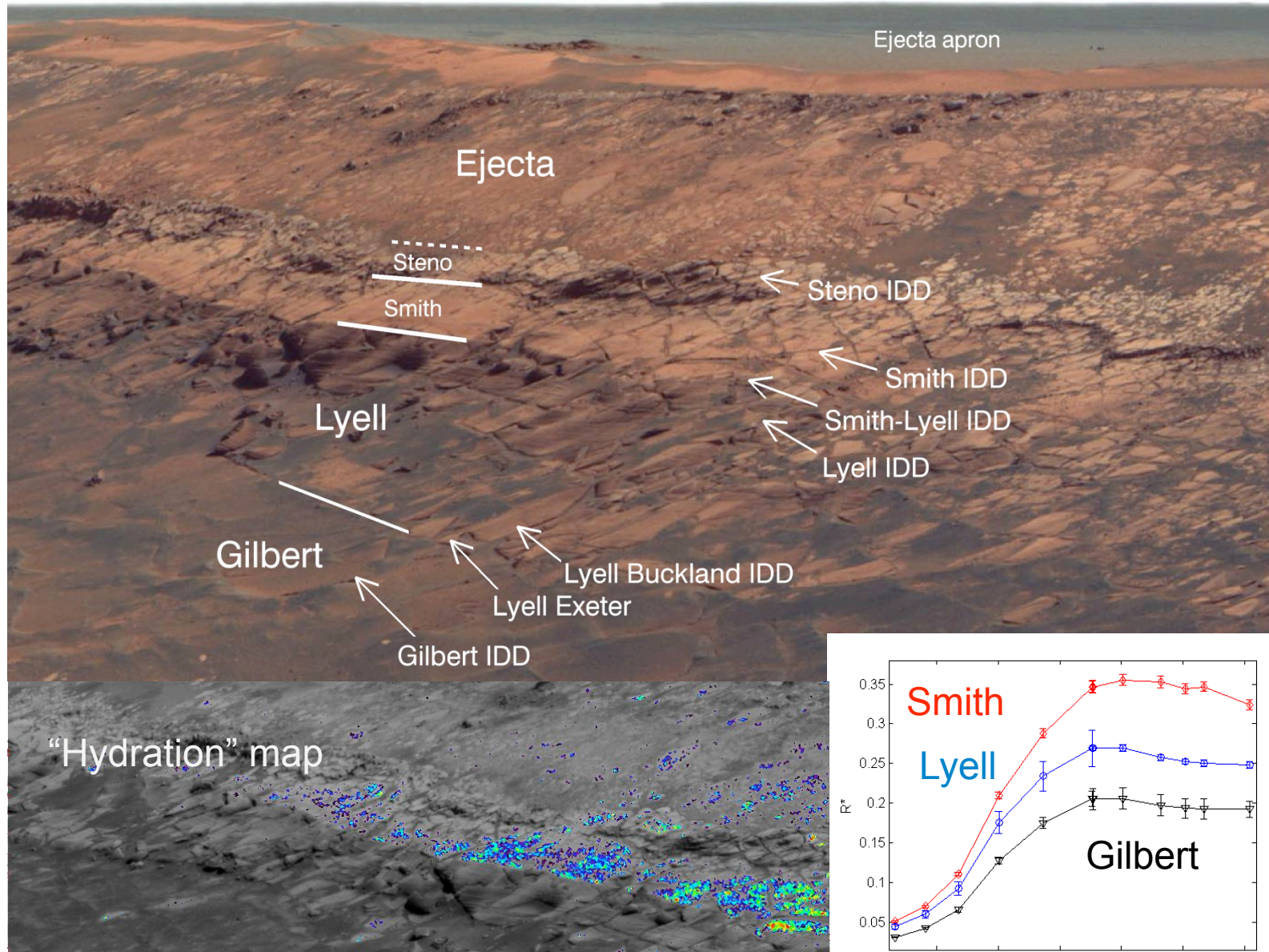


White box delineates geologic map shown in next slide

Bottomless Bay Geologic Sketch Map

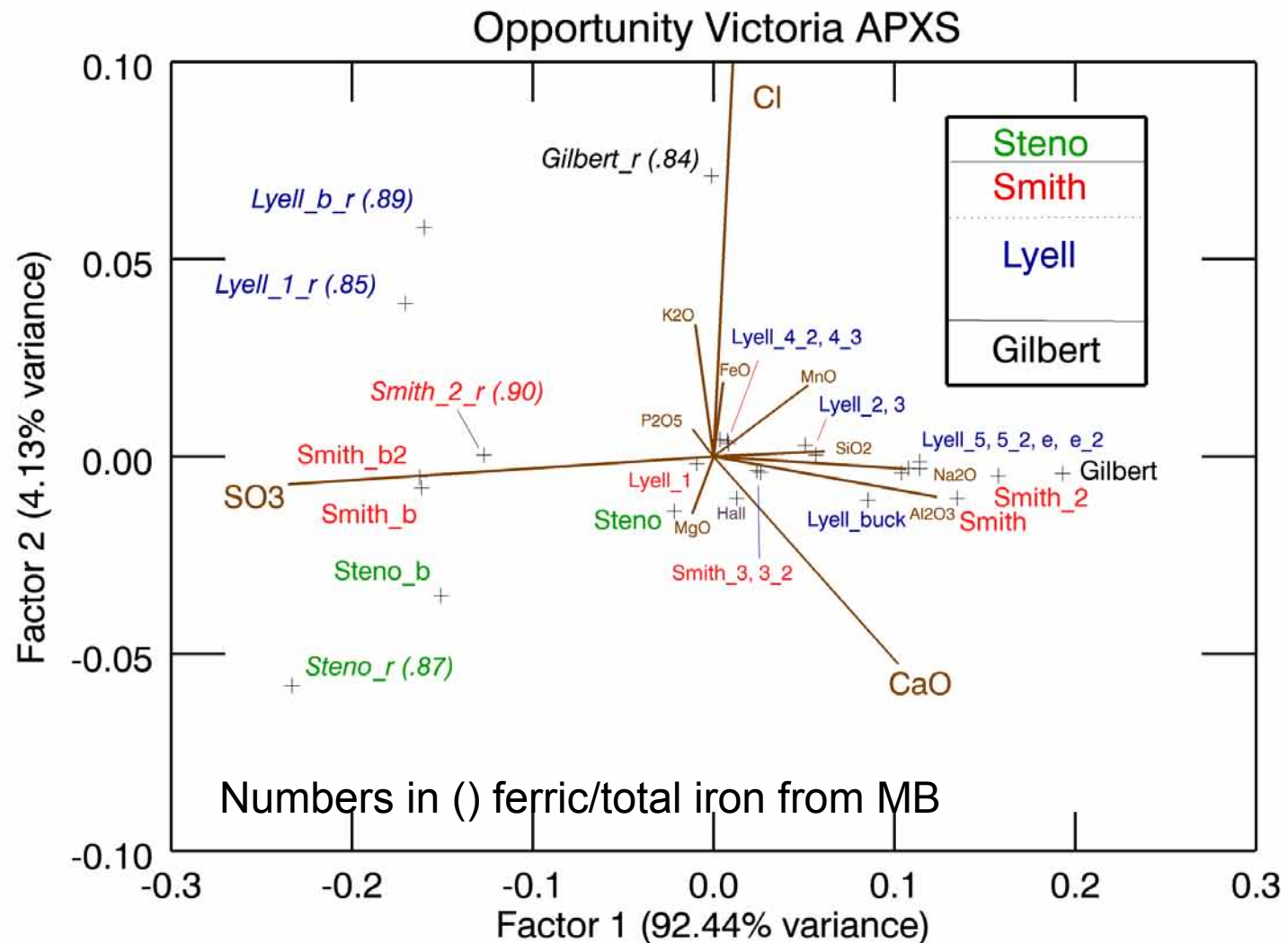


Duck Bay Opportunity In-situ Measurement Locations



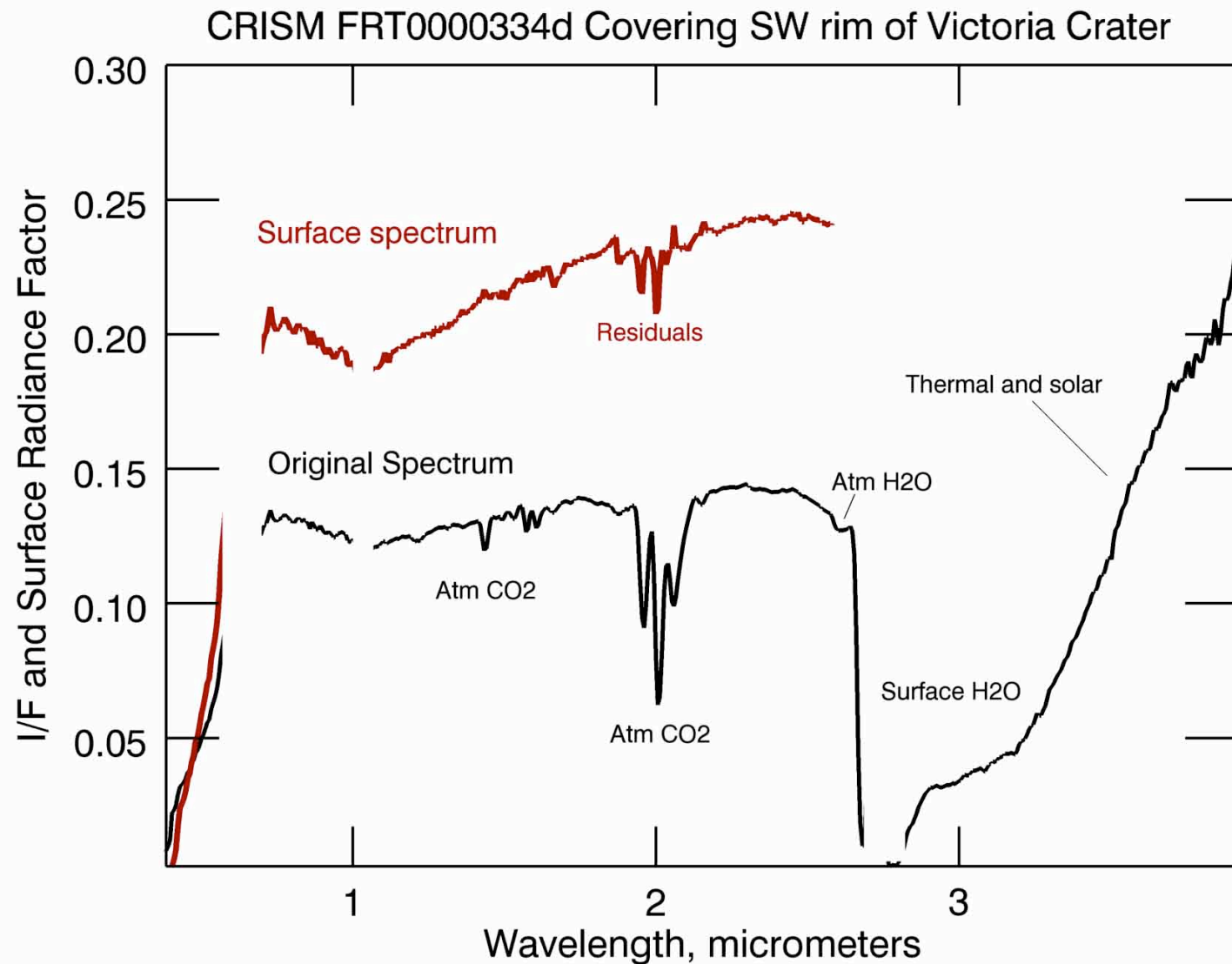
Opportunity APXS Measurements in Duck Bay: Ratted Surfaces Show Most Separation

b=brushed
r=ratted



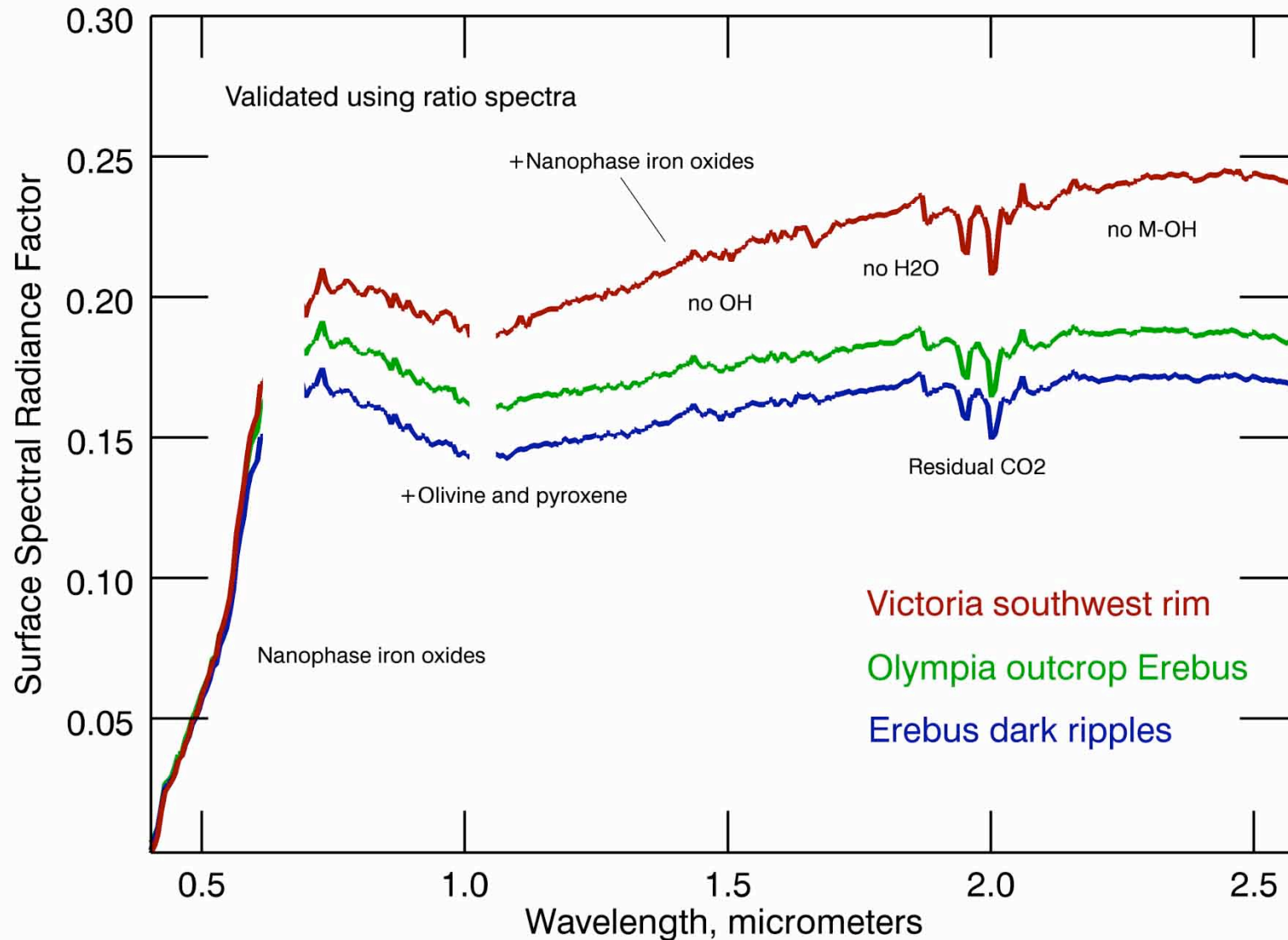
Deeper strata enriched in Cl and depleted in Mg, S relative to shallower layers

Retrieval of Surface Spectra From CRISM Data



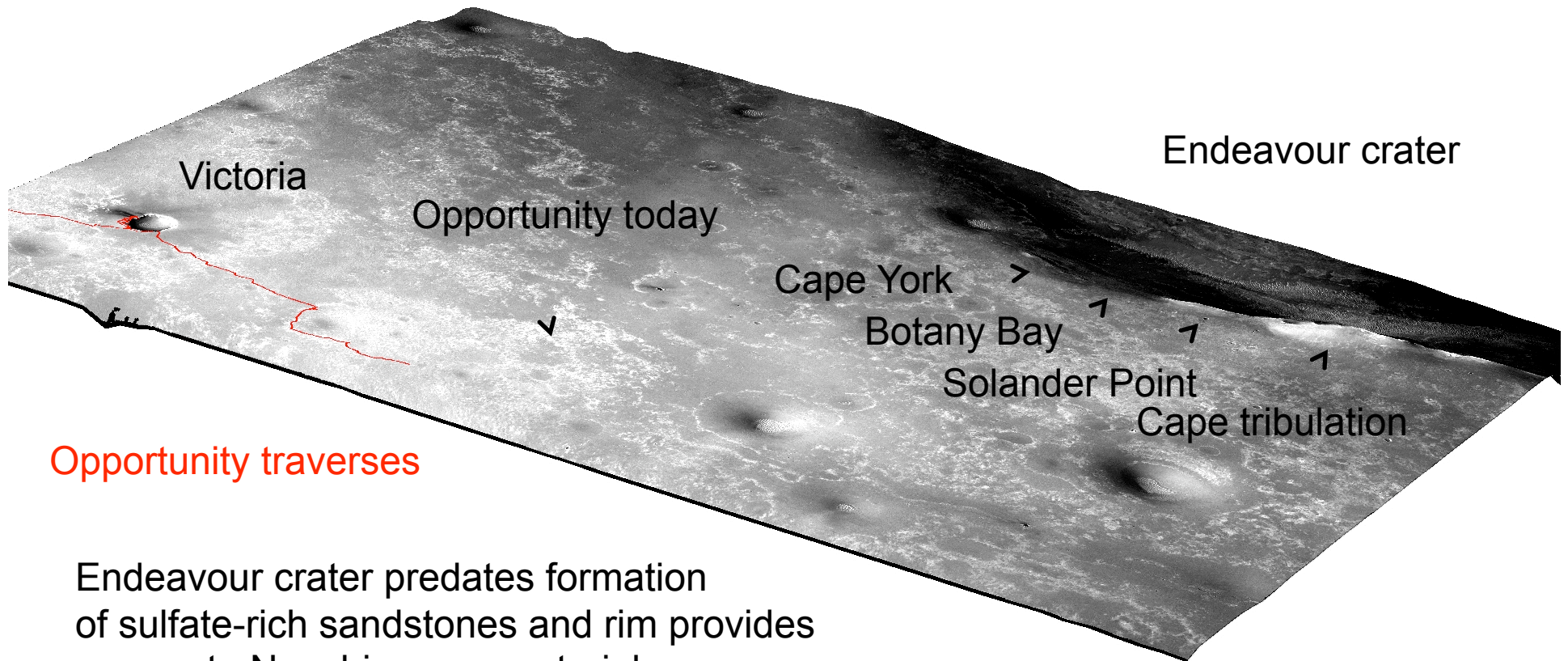
CRISM Mineral Retrievals are Consistent With Opportunity Observations

CRISM FRT0000334d Surface Spectra Indicative of Control by Grain Size and Electronic Transition Features



Opportunity's "go to" Site

CTX image Overlain onto DEM Created From CTX Stereo Pairs



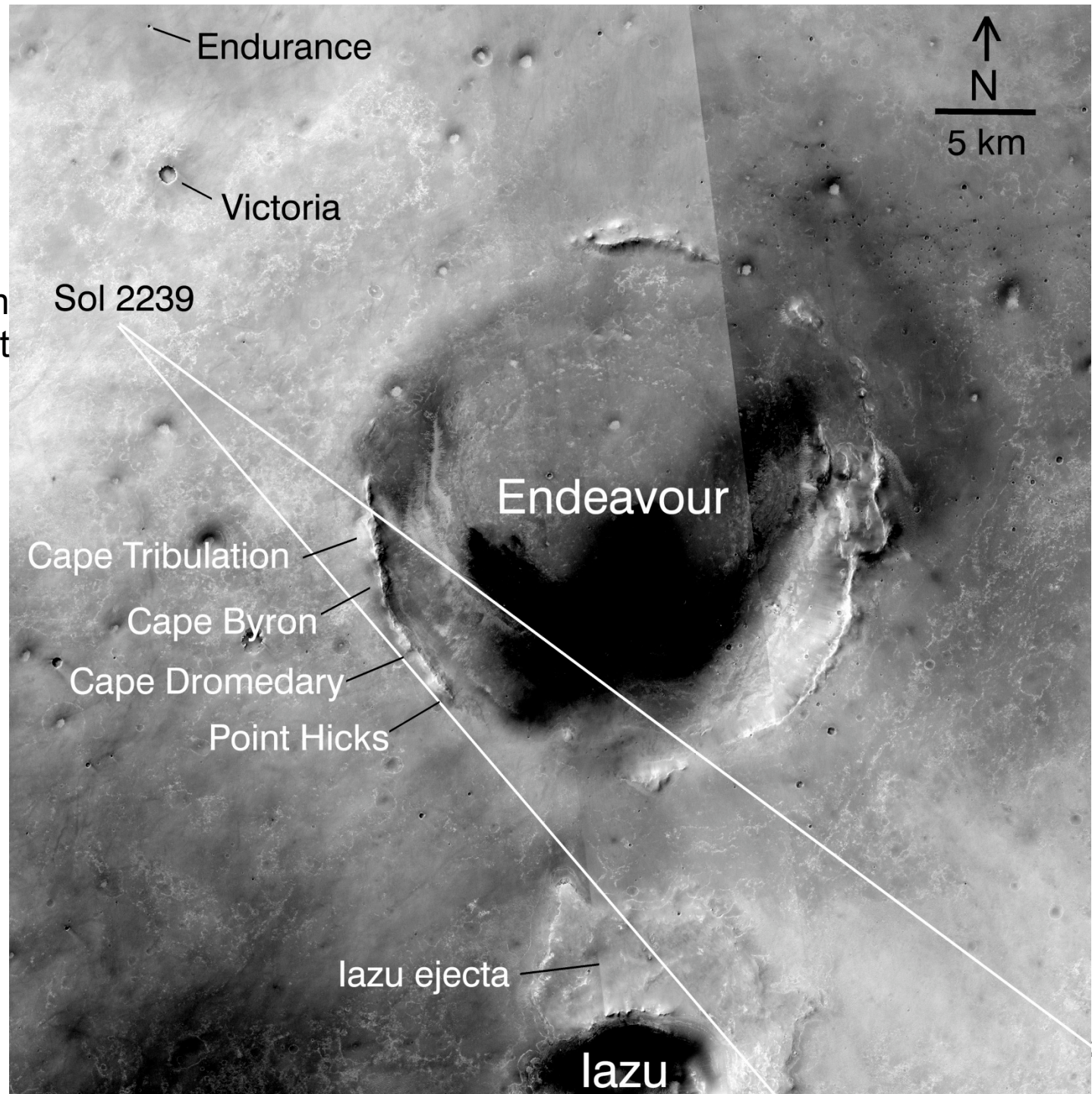
Opportunity traverses

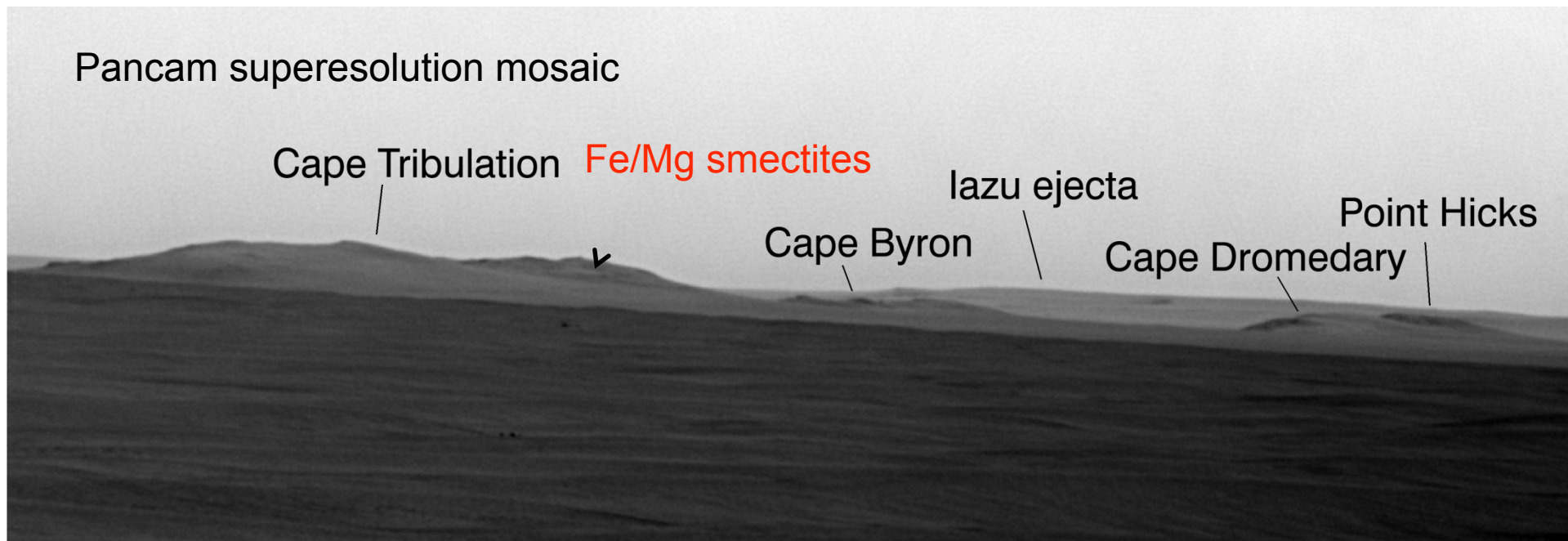
Endeavour crater predates formation of sulfate-rich sandstones and rim provides access to Noachian-age materials

Courtesy Sandra Wiseman

CTX image

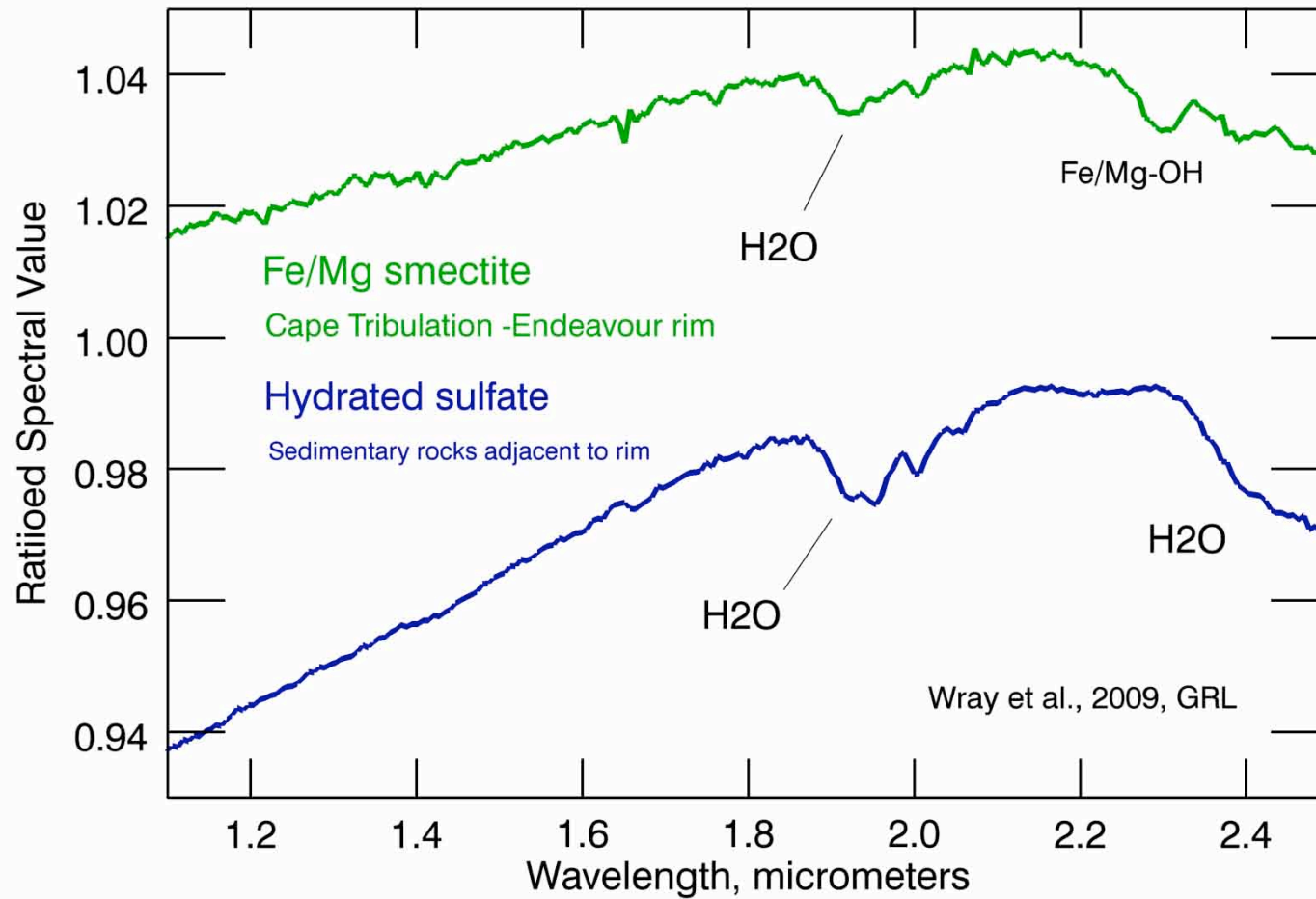
White lines
show Pancam
coverage next
slide





Cape Tribulation is ~100 m above adjacent plains

CRISM-based Detection of Phyllosilicate and Hydrated Sulfate Endeavour Crater



Geologic map
portion of
Endeavour rim

CRISM data

HiRISE data

Aeolian ripples
and bedrock

Hydrated sulfates
And hydrated phase(s)

Basaltic
materials

Fe/Mg smectite
exposures

Cape York

Botany Bay

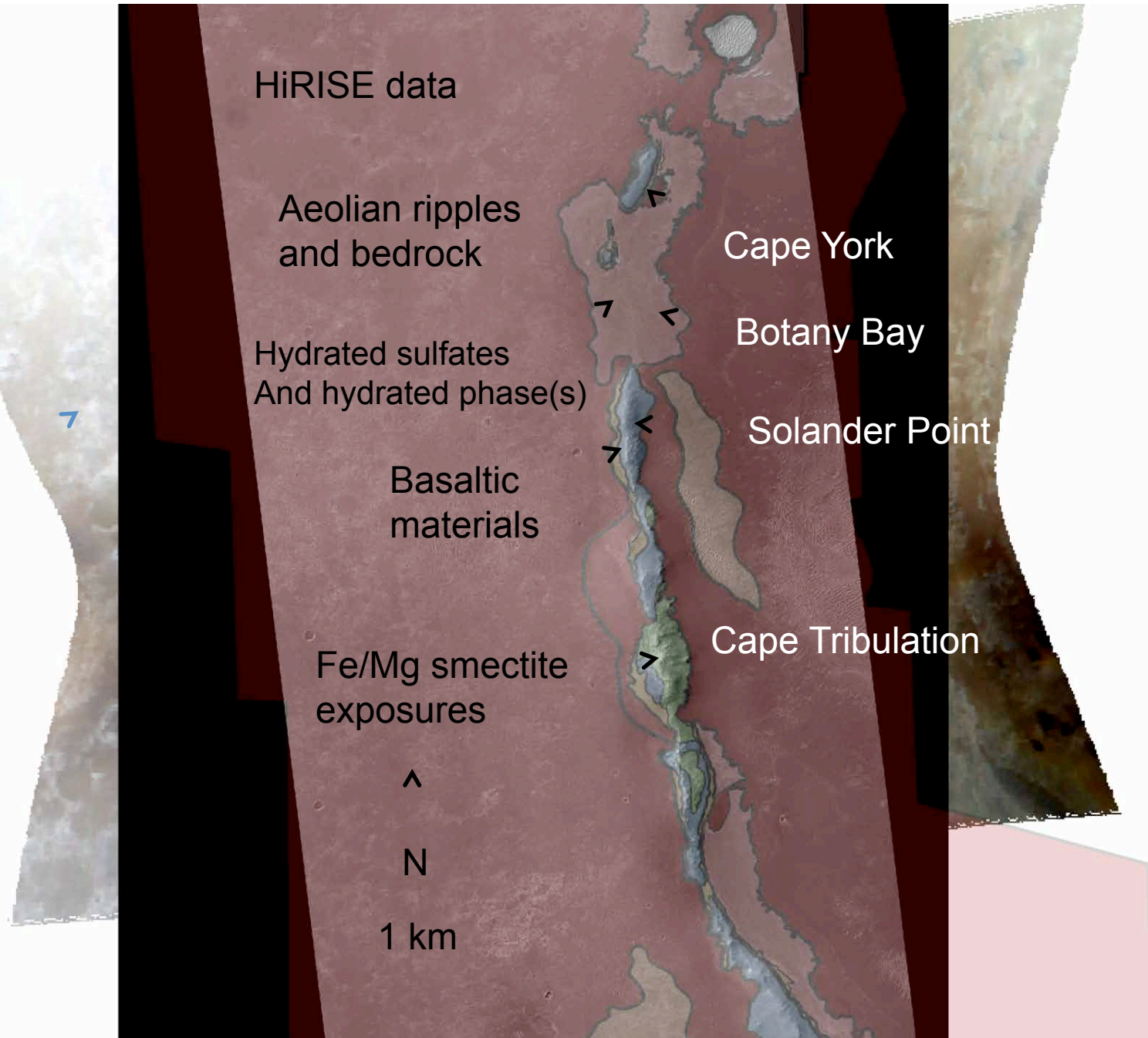
Solander Point

Cape Tribulation

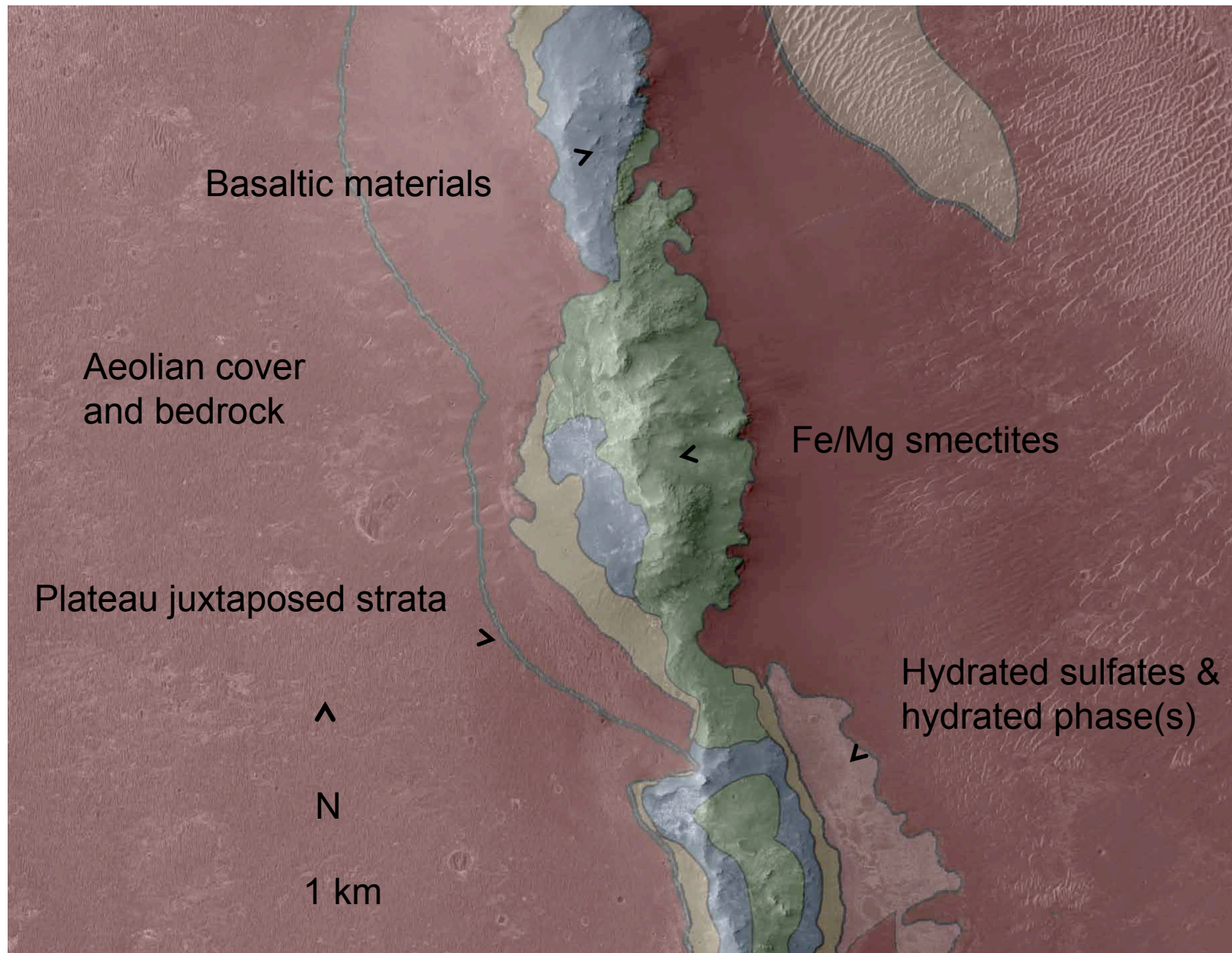
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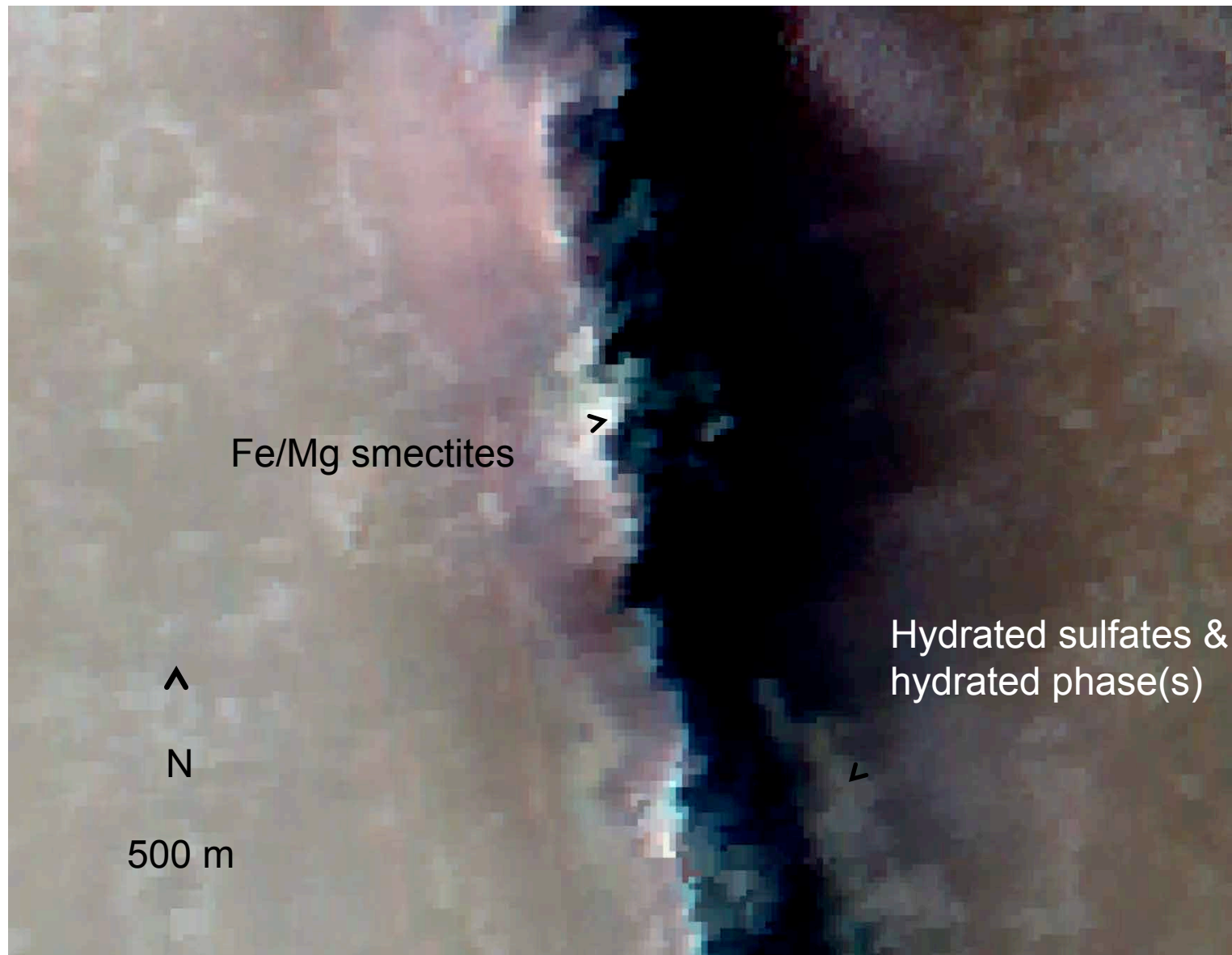
1 km



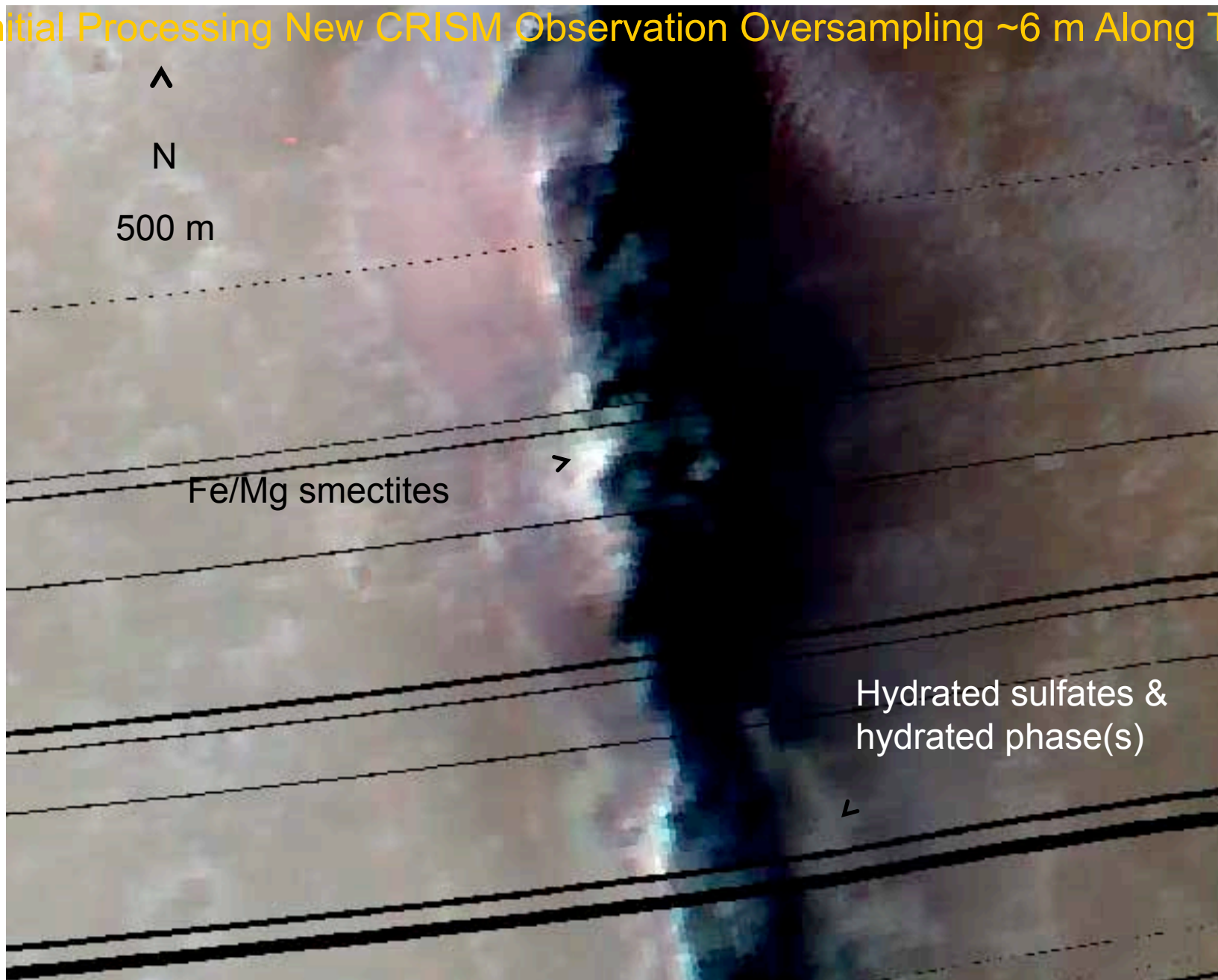
Detailed Geologic Map of Cape Tribulation



Normal CRISM False Color View Using 17.1 m/pixel Cape Tribulation



Initial Processing New CRISM Observation Oversampling ~6 m Along Track



Summary and Future Work

- Self-consistent model shows Meridiani Planum is bi-modal
 - *Granule ripple surface with hematitic concretions, basaltic sand and dust*
 - *Anhydrous sulfate-rich sandstone outcrops dominated spectrally by nanophase iron oxides*
- Processed CRISM data “end to end” using radiative transfer approaches to retrieve surface spectral radiance factors
 - *Working on residual features and longer wavelengths*
 - *Working on mineral abundances*
- Used new CRISM acquisition mode, oversampling along track
 - *Working on Backus-Gilbert method of pixel sharpening*
- Opportunity’s “go to” site on the rim of Endeavour offers access to Noachian materials, including Fe/Mg smectites. Sedimentary rocks adjacent to rim expose hydrated sulfates.
 - *Working on formal retrieval and modeling of spectra for each unit*
 - *MER Team considering drive directions and measurement plans*
 - *Hydrated sulfates represent “mud facies” source of sandstones?*
 - *Fe/Mg phyllosilicates produced in more neutral pH environment than sulfate-rich materials encountered thus far by Opportunity?*